I Claim:

1. A reactive magnetron sputter deposition apparatus for coating a substrate comprising:

a vacuum chamber evacuated to a low pressure;

at least one pulsed DC magnetron positioned within said vacuum chamber and having a target source for sputtered particles;

means for positioning a substrate within said vacuum chamber a long throw distance away from and facing said at least one pulsed DC magnetron; and

means for providing a reactant gas at said target source to form said sputtered particles, wherein operation of the pulsed DC magnetron prevents target poisoning by the reactant gas at said target source.

2. The apparatus of claim 1,

wherein said means for providing a reactant gas additionally provides an inert gas at said target source to form said sputtered particles.

3. The apparatus of claim 1,

wherein said low pressure is below about 1 mTorr.

4. The apparatus of claim 1,

wherein said long throw distance is greater than about 15 inches.

5. The apparatus of claim 1,

wherein said target source is smaller than the width/area of the substrate to be coated.

6. The apparatus of claim 5,

wherein said target source is smaller than the width/area of the substrate to be coated by at least a factor of three.

7. The apparatus of claim 1,

wherein said long throw distance is a function of the width/area of the substrate to be coated.

8. The apparatus of claim 7,

wherein said long throw distance is additionally a function of the number of said pulsed DC magnetrons/target sources utilized.

9. The apparatus of claim 1,

further comprising a plurality of pulsed DC magnetrons having a corresponding plurality of target sources.

10. The apparatus of claim 9,

wherein each additional target source reduces the partial pressure of the reactant gas of every target source without a corresponding reduction in the impingement ratio due to the increase in total ionization provided thereby.

11. The apparatus of claim 9,

wherein said means for providing a reactant gas additionally provides an inert gas at each target source to form said sputtered particles, and each additional target source reduces the partial pressure of at least the reactant gas for every target source without a corresponding reduction in the impingement ratio due to the increase in total ionization provided thereby.

12. The apparatus of claim 11,

wherein each additional target source additionally reduces the partial pressure of the inert gas for every target source to maintain said low pressure within said vacuum chamber.

13. A reactive magnetron sputter deposition process for coating large scale optics comprising:

providing a vacuum chamber evacuated to a low pressure;

providing at least one pulsed DC magnetron positioned within said vacuum chamber and having a target source for sputtered particles;

providing means for positioning a substrate within said vacuum chamber a long throw distance away from and facing said at least one pulsed DC magnetron; and

impinging said target source with a reactant gas to sputter said particles onto the substrate, wherein operation of the pulsed DC magnetron prevents target poisoning by the reactant gas at said target source.

14. The process of claim 13,

further comprising impinging said target source with an inert gas at said target source to sputter said particles onto the substrate.

15. The process of claim 13,

wherein said low pressure is below about 1 mTorr.

16. The process of claim 13,

wherein said long throw distance is greater than about 15 inches.

17. The process of claim 13,

wherein said target source is smaller than the width/area of the substrate to be coated.

18. The process of claim 17,

wherein said target source is smaller than the width/area of the substrate to be coated by at least a factor of three.

19. The process of claim 13,

wherein said long throw distance is a function of the width/area of the substrate to be coated.

20. The process of claim 19,

wherein said long throw distance is additionally a function of the number of said pulsed DC magnetrons/target sources utilized.

21. The process of claim 13,

further comprising a plurality of pulsed DC magnetrons having a corresponding plurality of target sources.

22. The process of claim 21,

wherein each additional target source reduces the partial pressure of the reactant gas of every target source without a corresponding reduction in the impingement ratio due to the increase in total ionization provided thereby.

23. The process of claim 21,

wherein said means for providing a reactant gas additionally provides an inert gas at each target source to form said sputtered particles, and each additional target source reduces the partial pressure of at least the reactant gas for every target source without a corresponding reduction in the impingement ratio due to the increase in total ionization provided thereby.

24. The process of claim 23,

wherein each additional target source additionally reduces the partial pressure of the inert gas for every target source to maintain said low pressure within said vacuum chamber.